PERSONAL AND AREA SELF-INDICATING INSTANT RADIATION ALERT DOSIMETER

CROSS-REFERENCE TO RELATED APPLICATIONS

This invention is a divisional applicant of U.S. patent application Ser. No. 11/930,529 filed Oct. 31, 2007, now U.S. Pat. No. 8,115,182, issued Jan. 14, 2012, which is, in turn, a continuation-in-part application of pending U.S. patent application Ser. No. 10/545,796 filed Aug. 16, 2005 which claims priority to PCT/US04/05860 filed Feb. 26, 2004 which claims priority to U.S. Provisional Patent Application No. 60/450,267 filed Feb. 27, 2003 all of which are incorporated herein by reference.

STATEMENT OF FEDERAL FUNDING

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to radiation sensitive devices, such as a film, sticker or badge for monitoring a dose of high-energy radiations, such as ultraviolet (UV) radiation, electrons, X-rays, protons, alpha particles and neutrons utilizing radiation sensitive materials, such as diacetylenes.

2. Brief Description of Prior Art

High energy radiations, including those having energy higher than 4 eV, such as UV light, X-rays, gamma rays, electrons, protons, alpha particles, neutrons, and laser radiation are used for a variety of applications, such as sterilization of medical supplies and perishables, curing of coatings and cross-linking of polymers, recording of images and information, radiography, nondestructive testing and diagnostic and radiation therapy. Their exposure needs to be monitored. Electronic equipment for monitoring radiation is expensive. There is a need for a simple dosimeter which can be used for monitoring a very low dose to a very high dose, such as 0.1 rad to 10 megarads (Mrads) of radiation having energy of 4 eV to 100 MeV.

In the case of a terrorist attack with a radiological dispersion device often referred to as "dirty bomb", an accident at a nuclear power plant or nuclear powered ship/submarine, or a nuclear explosion, the first responders and people affected by them want to know, "Did I receive a lethal exposure to ionizing radiation or will I be OK?" Medical personnel treating the victims need to quickly assess the radiation dose each individual has received to ensure that treatment is provided first to those who need it the most. We have developed a credit card-sized radiation dosimeter that answers those questions quickly and cheaply. The badge can be worn for months to years. When exposed to radiation from a "dirty bomb", or nuclear detonation, the sensing material changes color providing the wearer or medical personnel instantaneous information on cumulative radiation exposure of the victim. It can take days to get that information by other methods.

The following is the list of some exposure limits and symptoms for various dosages of high energy radiation (mRem=millirem and mSv=milli Sievert):

Public dose limits due to licensed activities	100	mRem/year
Lumbar/spinal x-rays	130	mRem/exposure
Pelvis/Hip x-ray	170	mRem/exposure
Upper GI series	245	mRem/exposure
Cumulative Natural Background	300	mRem/year
Lower GI series	405	mRem/exposure
Occupational Exposure Limits for Minors	500	mRem/year
Occupational Exposure Limits for Fetus	500	mRem
Occupational Limits- DDE	5,000	mRem/year
Occupational Limits - SDE (skin)	50,000	mRem/year
Occupational Limits- SDE (extremities)	50,000	mRem/year
Occupational Limits - LDE (lens of eye)	15,000	mRem/year
Diagnostic thyroid exam	90,000	mRad/exposure
Therapeutic thyroid exam	1,000,000	mRad/exposure
Dose to cause acute radiation sickness	~1000	mSv
Dose leading to a 50% chance of death from acute symptoms	>4500	mSv

It is well established that high dose ionizing radiation can cause cancer. The effect and symptoms of a high dose are well known.

0 to 25 rads	No easily detectable clinical effect in humans. However, at about 15 rads there could be temporary sterility (Testis).
25 to 100 rads	Slight short-term reduction in blood cells. Disabling sickness not common.
100 to 200 rads	Nausea and fatigue. Vomiting if dose is greater than 125 rads. Longer-term reduction in number of some types of blood cells.
200 to 300 rads	Nausea and vomiting on the first day of exposure. Up to a two-week latent period followed by appetite loss, general malaise, sore throat, pallor, diarrhea, and moderate emaciation. Recovery in about three months unless complicated by infection or injury.
300 to 600 rads	Nausea, vomiting, and diarrhea in first few hours. Up to a one-week latent period followed by loss of appetite, fever, and general malaise in the second week. Followed by bleeding, inflammation of mouth and throat, diarrhea, and emaciation. Some deaths in two to six weeks. Eventual death for 50% if exposure is above 450 rems. Others recover in about six months.
Over 600 rem	Nausea, vomiting, and diarrhea in the first few hours. Followed by rapid emaciation and death in 2nd week. Eventual death of nearly 100%. High dose could lead to death.

There is no doubt that radiation can cause cancer. The question is what level of radiation it takes to cause cancer. The risk for radiation exposure has been very widely studied. The general consensus of opinion for the induction of cancer by ionizing radiation is 10% increase in cancer rate/Sv when the dose is given over a short time with a decrease to 5% when the dose is protracted over an extended time period. One Sv is equal to 1000 mSv and one mSv is equal to 100 mRem. Therefore a 10% increase in cancer is related to a dose of 100,000 mRem with 5% if the dose is protracted over a longer period of time. If one receives a harmful level of dose of ionizing radiation (e.g., 1-1,000 rads), one needs to know immediately so that proper medical care can be given. Dosimeters for dose higher than a few thousand rads have been reported (Standards on Dosimetry for Radiation Processing,